

I CLAIM:

1. A method of conditioning an audio signal on a first set of channels to be reconfigured onto a second set of channels, comprising:

5 for each channel in said first set, establishing mapping coefficients in the form of digitally encoded signals that map audio signal levels on said channel onto desired signal levels for each channel in said second set, and

10 storing said audio signal on said first set of channels along with said mapping coefficient signals on a digital medium from which both the first set of channels and the coefficients can be read.

2. The method of claim 1, wherein said mapping coefficients are established by generating said audio signal on said second set of channels with a desired distribution of said audio signal among the channels of said second set, 5 comparing the signal on each channel in said first set with the signal on each channel in said second set, and establishing said coefficients based upon said comparisons.

3. The method of claim 1, wherein said coefficients are establishing by dividing said signal on said first set of channels into multiple spectral bands, and establishing mapping coefficients for each of said spectral bands.

4. The method of claim 1, wherein said coefficients are established by dividing said signal on said first set of channels into overlapping temporal aperture periods, and establishing sets of coefficients for each of said aperture 5 periods.

5. The method of claim 1, wherein said audio signal

is stored on said digital medium as a series of multibit words, and said coefficients are encoded onto lower order bits of said words.

6. The method of claim 5, where said coefficients are encoded onto the least significant bit of a fractional number of said words.

7. The method of claim 1, further comprising the steps of reading said audio signal on said first set of channels and said coefficients from said digital medium, and applying said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

8. The method of claim 7, wherein said coefficients are applied to said audio signal by multiplying, for each channel in said second set, the audio signal on each channel of the first set by its respective coefficient for said second set channel, and accumulating the results of said multiplications for each second set channel.

9. The method of claim 8, wherein said coefficients are established by dividing said signal on said first set of channels into multiple spectral bands for each channel and establishing said coefficients as spectral mapping coefficients (SMCs) for each of said spectral bands, and said coefficients are applied to said signal by multiplying, for each channel in said second set, the audio signal within each spectral band of each channel of the first set by its respective SMC for said second set channel.

10. The method of claim 1, wherein the mapping coefficients for each of said first set of channels define a vector that allocates a distribution of at least a portion

5 of the signal on said channel among the channels of the second set.

11. The method of claim 10, wherein the distribution of the signals on said first set of channels among said second set of channels is partially predetermined and partially allocated by said vectors.

12. The method of claim 11, wherein the predetermined portions of the signal distributions are distributed equally among said second set of channels.

5 13. The method of claim 10, further comprising the steps of reading said audio signal on said first set of channels and said vectors from said digital medium, establishing the mapping coefficients that correspond to each of said vectors, and applying said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

14. The method of claim 13, wherein the mapping coefficients that correspond to each of said vectors are established from at least one lookup table.

15. A method of reproducing on a second set of channels an audio signal present on a first set of channels, comprising:

5 providing said audio signal in digital format on said first set of channels along with a set of digitally formatted mapping coefficients that, for each channel in said first set, map the audio signal level of said channel onto respective channels of said second set of channels,

10 reading said audio signal on said first set of channels and said coefficients, and

applying said coefficients to said audio signal

on said first set of channels to obtain the audio signal on said second set of channels.

16. The method of claim 15, wherein said coefficients are applied to said audio signal by multiplying, for each channel in said second set, the audio signal on each channel of the first set by its respective coefficient for said second set channel, and accumulating the results of said multiplications for each second set channel.

17. The method of claim 16, wherein said coefficients comprise spectral mapping coefficients (SMCs) for respective spectral bands of the audio signal on each channel of said first set, and said coefficients are applied to said signal by multiplying, for each channel in said second set, the audio signal within each spectral band of each channel of the first set by its respective SMC for said second set channel.

18. The method of claim 15, wherein the mapping coefficients for each of said first set of channels are stored on said digital medium as respective vectors that allocate a distribution of at least a portion of the signal on said channel among the channels of said second set, said coefficients are read from said digital medium in the form of said vectors, and the coefficients that are applied to said audio signal on said first set of channels to obtain the audio signal on said second set of channels are derived from said vectors.

19. The method of claim 18, wherein said coefficients are derived from said vectors by storing coefficients for different vectors in a lookup table, and obtaining coefficients from the lookup table that correspond to the vectors read from said digital medium.

20. A method of conditioning an audio signal on monaural or stereo source channels to be reconfigured into a multi-channel format of target channels, comprising:

5 dividing the signal on each source channel into multiple spectral bands,

establishing spectral mapping coefficients (SMCs) that, for each band of each source channel, map the signal level within said band onto desired signal levels for a corresponding spectral band of each target channel, and

10 storing said audio signal on said source channels along with said SMCs on a digital medium from which both the source channels and the SMCs can be read.

21. The method of claim 20, wherein said SMCs are established by generating said audio signal on said target channels with a desired distribution of said signal among said target channels, comparing the signal within each spectral band of each source channel with the signal within the corresponding spectral band of each target channel to obtain ratios between the compared signals, and establishing said SMCs based upon said ratios.

22. The method of claim 20, wherein said SMCs are established by dividing said audio signal on said source channels into overlapping temporal aperture periods, and establishing sets of SMCs for each of said aperture periods.

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23. The method of claim 20, wherein said audio signal is stored on said digital medium as a series of multibit words, and said SMCs are encoded onto lower order bits of said words.

24. The method of claim 23, wherein said SMCs are

encoded onto the least significant bit of a fractional number of said words.

25. The method of claim 20, further comprising the steps of reading said audio signal on said source channels and said SMCs from said digital medium, and applying said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

26. The method of claim 25, wherein said SMCs are applied to said audio signal by multiplying, for each target channel, the audio signal on each source channel by its respective SMC for said target channel, and accumulating the results of said multiplications for each target channel.

27. The method of claim 20, wherein said SMCs for each source channel define a vector that allocates a distribution of at least a portion of the audio signal on said channel among said target channels.

28. The method of claim 27, wherein the distribution of the signals on said source channels among said target channels is partially predetermined and partially allocated by said vectors.

29. The method of claim 28, wherein the predetermined portions of the signal distributions are distributed equally among said target channels.

30. The method of claim 27, further comprising the steps of reading said audio signal on said source channels and said vectors from said digital medium, establishing the SMCs that correspond to each of said vectors, and applying said SMCs to said audio signal on said source channels to

obtain the audio signal on said target channels.

31. The method of claim 30, wherein the SMCs that correspond to each of said vectors are established from at least one lookup table.

32. A method of reproducing on two or more target channels an audio signal present on monaural or stereo source channels, comprising:

5 providing said audio signal in digital format on said source channels along with a set of spectral mapping coefficients (SMCs) that, for each band of each source channel, map the signal level within that band onto desired signal levels for corresponding bands of each of said target channels,

10 reading said audio signal on said source channels and said SMCs, and

applying said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

33. The method of claim 32, wherein said SMCs are applied to said audio signal by multiplying, for each target channel, the audio signal on each band of each source channel by its respective SMC for said target channel, and
5 accumulating the results of said multiplications for each band of each target channel.

34. The method of claim 32, for SMCs for each source channel that are stored on said digital medium as respective vectors that allocate a distribution of at least a portion of the audio signal on said source channel among the target channels, wherein said SMCs are read from said digital medium in the form of said vectors, and the SMCs that are applied to said audio signal on said source chan-

nels to obtain the audio signal on said target channels are derived from said vectors.

35. The method of claim 34, wherein said SMCs are derived from said vectors by storing SMCs for different vectors in at least one lookup table, and obtaining SMCs from the lookup tables that correspond to the vectors read from said digital medium.

36. An audio signal conditioning circuit for conditioning an audio signal on a first set of channels to be reconfigured onto a second set of channels, comprising:

5 a mapping coefficient generating circuit that, for each channel in said first set, establishes mapping coefficients in the form of digitally encoded signals that map audio signal levels on said channel onto desired signal levels for each channel in said second set, and

10 a transfer circuit connected to apply said audio signal on said first set of channels along with said mapping coefficient signals to a digital medium.

37. The circuit of claim 36, further comprising a mixer that mixes a multitrack master audio signal into a desired distribution among the second set of channels, wherein said coefficient generating circuit includes a circuit that compares the signal on each channel in the first set with the signal on each channel in the second set to establish said coefficients.

38. The circuit of claim 36, wherein said coefficient generating circuit establishes said coefficients by dividing the signal on said first set of channels into multiple spectral bands for each channel, and establishing mapping coefficients for each of said spectral bands.

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39. The circuit of claim 36, wherein said coefficient generating circuit establishes said coefficients by dividing the signal on said first set of channels into overlapping temporal aperture periods, and establishing sets of 5 coefficients for each of said aperture periods.

40. The circuit of claim 36, wherein said transfer circuit applies said audio signal to said digital medium as a series of multibit words, with said coefficients encoded onto lower order bits of said words.

41. The circuit of claim 40, where said transfer circuit encodes said coefficients onto the least significant bit of a fractional number of said words.

42. The circuit of claim 36, further comprising a receive circuit connected to read said audio signal on said first set of channels and said coefficients from said digital medium, and a decoding circuit connected to apply said 5 coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

43. The circuit of claim 42, wherein said decoding circuit includes multipliers connected to multiply, for each channel in said second set, the audio signal on each channel of the first set by its respective coefficient for 5 said second set channel, and accumulators connected to accumulate the results of said multiplications for each second set channel.

44. The circuit of claim 43, wherein said coefficient generating circuit establishes said coefficients by dividing said signal on said first set of channels into multiple spectral bands for each channel and establishing said coef-

5 ficients as spectral mapping coefficients (SMCs) for each
of said spectral bands, and said multipliers are connected
to multiply, for each channel in said second set, the audio
signal within each spectral band of each channel of the
first set by its respective SMC for said second set chan-
10 nel.

45. The circuit of claim 36, wherein said coefficient
generating circuit generates the coefficients for each of
said first set of channels as a vector that allocates a
distribution of at least a portion of the signal on said
5 channel among the channels of the second set.

46. The circuit of claim 45, wherein said coefficient
generating circuit generates said vectors so that the dis-
tribution of the signals on said first set of channels
among said second set of channels is partially predeter-
5 mined and partially allocated by said vectors.

47. The circuit of claim 45, further comprising a
receive circuit that reads said audio signal on said first
set of channels and said vectors from said digital medium,
and a decoding circuit that establishes the mapping coef-
5 ficients that correspond to each of said vectors and appli-
es said coefficients to said audio signal on said first set
of channels to obtain the audio signal on said second set
of channels.

48. The circuit of claim 47, wherein said decoding
circuit includes at least one lookup table that maps said
vectors onto corresponding sets of mapping coefficients.

49. A circuit for reproducing on a second set of
channels an audio signal present on a first set of chan-
nels, comprising:

5 a receive circuit connected to read said audio signal on said first set of channels along with a set of mapping coefficients from that, for each channel in said first set, map the audio signal level of said channel onto respective channels of said second set of channels, and

10 a decoding circuit connected to apply said coefficients to said audio signal on said first set of channels to obtain the audio signal on said second set of channels.

50. The circuit of claim 49, wherein said decoding circuit includes multipliers connected to multiply, for each channel in said second set, the audio signal on each channel of the first set by its respective coefficient for said second set channel, and accumulators connected to accumulate the results of said multiplications for each second set channel.

51. The circuit of claim 50, for coefficients that comprise spectral mapping coefficients (SMCs) for respective spectral bands of the audio signal on each channel of said first set, wherein said multipliers are connected to multiply, for each channel in said second set, the audio signal within each spectral band of each channel of the first set by its respective SMC for said second set channel.

52. The circuit of claim 49, for coefficients for each of said first set of channels in the form of respective vectors that allocate a distribution of at least a portion of the signal on said channel among the channels of said second set, wherein said receive circuit is connected to read said coefficients in the form of said vectors, and said decoding circuit derives said coefficients from said vectors for application to said audio signal on said first set of channels.

53. The circuit of claim 52, wherein said decoding circuit includes at least one lookup table that maps said vectors onto corresponding sets of coefficients.

54. An audio signal conditioning circuit for conditioning an audio signal on monaural or stereo source channels to be reconfigured into a multi-channel format having at least two target channels, comprising:

5 a spectral decomposition circuit connected to divide the signal on each source channel into multiple spectral bands, and

10 a spectral mapping coefficient (SMC) generating circuit that, for each band of each source channel, establishes SMCs that map the signal level within said band onto desired signal levels for a corresponding spectral band of each target channel.

55. The circuit of claim 54, further comprising a mixer that mixes a multitrack master audio signal into a desired distribution among said target channels, wherein said SMC generating circuit includes a circuit that compares the signal within each spectral band of each source channel with the signal within the corresponding spectral band of each target channel to obtain ratios between the compared signals, and establishes said SMCs based upon said ratios.

56. The circuit of claim 54, wherein said SMC generating circuit establishes said SMCs by dividing said audio signal on said source channels into overlapping temporal aperture periods, and establishing sets of SMCs for each of said aperture periods.

57. The circuit of claim 54, further comprising a

transfer circuit connected to apply said audio signal on said source channels to a digital medium as a series of multibit words, with said SMCs encoded onto lower order 5 bits of said words.

58. The circuit of claim 57, wherein said transfer circuit encodes said SMCs onto the least significant bit of a fractional number of said words.

59. The circuit of claim 54, further comprising a transfer circuit connected to apply said audio signal on said source channels along with said SMCs to a digital medium, a receive circuit connected to read said audio signal on said source channels and said SMCs from said digital medium, and a decoding circuit connected to apply said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

60. The circuit of claim 59, wherein said decoding circuit includes multipliers connected to multiply, for each target channel, the audio signal on each source channel by its respective SMC for said target channel, and accumulators connected to accumulate the results of said multiplications for each target channel.

61. The circuit of claim 54, wherein said SMC generating circuit generates the SMCs for each source channel as a vector that allocates a distribution of at least a portion of the audio signal on said source channel among said 5 target channels.

62. The circuit of claim 61, wherein said SMC generating circuit generates said vectors so that the distribution of the signals on said source channels among said target channels is partially predetermined and partially allo-

5 cated by said vectors.

63. The circuit of claim 61, further comprising a transfer circuit connected to apply said audio signal on said source channels along with said SMCs to a digital medium, a receive circuit that reads said audio signal on said source channels and said vectors from said digital medium, and a decoding circuit that establishes the SMCs that correspond to each of said vectors and applies said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

5 64. The circuit of claim 63, wherein said decoding circuit includes at least one lookup table that maps said vectors onto corresponding sets of SMCs.

65. A circuit for reproducing on at least two target channels a multispectral band audio signal present on monaural or stereo source channels, comprising:

5 a receive circuit connected to read said audio signal on said source channels along with a set of spectral mapping coefficients (SMCs) that, for each band of each source channel, map the signal level within that band onto desired signal levels for corresponding bands of each of said target channels, and

10 a decoding circuit connected to apply said SMCs to said audio signal on said source channels to obtain the audio signal on said target channels.

66. The circuit of claim 65, wherein said decoding circuit includes multipliers connected to multiply, for each target channel, the audio signal on each band of each source channel by its respective SMC for said target channel, and accumulators connected to accumulate the results of said multiplications for each band of each target chan-

nel.

67. The circuit of claim 65, for SMCs for each source channel in the form of respective vectors that allocate a distribution of at least a portion of the audio signal on said source channel among the target channels, wherein said receive circuit is connected to read said SMCs in the form of said vectors, and said decoding circuit derives said SMCs from said vectors for application to said audio signal on said source channels.

68. The circuit of claim 67, wherein said decoding circuit includes at least one lookup table that maps said vectors onto corresponding sets of SMCs.

69. A method of allocating an audio signal among a plurality of output channels, comprising:

5 providing an audio signal,
providing a vector signal that defines a spatial vector,

establishing a correspondence between different vectors and different allocations of said audio signal among a plurality of output channels,

10 determining the allocation that corresponds to the vector defined by said vector signal, and

allocating said audio signal among said output channels based upon the allocation thus determined.

70. The method of claim 69, wherein said vector signal is provided as a dynamically changing signal, and the allocation of said audio signal among said output channels is dynamically varied in accordance with the dynamic variation in said vector signal.

71. The method of claim 69, wherein said correspon-

5 dence is established by establishing different sets of co-efficient for different vectors, and said allocation is determined by applying said coefficients to said audio signal to determine the portion of the audio signal for each output channel.

72. The method of claim 71, wherein separate vector signals are provided for different spectral bands of said audio signal, and said coefficients are established as respective sets of spectral mapping coefficients (SMCs) that map the audio signal within respective corresponding spectral bands onto separate allocations of said audio signal among said output channels for the different bands.

5 73. The method of claim 71, wherein said vector-speaker allocation correspondence is stored in at least one lookup table, and the output channel allocation for a particular vector is determined from said lookup tables.

74. The method of claim 73, wherein said audio signal is provided on multiple input channels, a separate vector signal is provided for each input channel, and separate lookup tables are provided for said separate vector signals.

5 75. The method of claim 69, wherein the allocation of said audio signal among said output channels is partially determined by said vector and partially predetermined.

76. The method of claim 75, wherein said predetermined allocation comprises a balanced allocation among said output channels.

77. The method of claim 69, wherein said vector signal includes a set of vector polar coordinates.

78. The method of claim 69, wherein said vector signal includes a set of vector grid coordinates.

79. A method of encoding an audio signal for allocation among a plurality of output channels, comprising:

generating vector signals that define different spatial vectors corresponding to different allocations of said audio signal among said channels, and

5 applying said audio signal along with said vector signals in digital format to a digital medium.

80. The method of claim 79, wherein said different vector signals are applied to said digital medium in a time sequence as a dynamically varying signal.

81. The method of claim 79, wherein each of said vector signals defines a respective spatial vector that corresponds to a respective allocation of said audio signal among at least two output channels.

82. The method of claim 79, wherein separate vector signals are generated and applied to said digital medium for separate spectral bands of said audio signal.

83. The method of claim 79, wherein the correspondence between at least some of said vectors and desired allocations of said audio signal among said output channels is only partial.

84. The method of claim 79, wherein said vector signals are generated with respective sets of vector polar coordinates.

85. The method of claim 79, wherein said vector sig-

nals are generated with respective sets of vector grid coordinates.